

Summary
Final Proposal
Industrial Landfill Operation

US EPA RECORDS CENTER REGION 5



479276

Miles Experimental Industrial Landfill
Elkhart County

Description: Miles Laboratories, Inc., of Elkhart, is proposing to operate an industrial disposal operation for the disposal of calcium sulfate only. The site is located within the SE $\frac{1}{4}$, SW $\frac{1}{4}$, of Section 25, T38N., R4E., Elkhart County. The operation will be conducted on an experimental basis beginning with Parcel I which contains approximately 30 acres. The disposal of calcium sulfate will take place only as an alternative in the event the Himco Landfill or other approved disposal method is unavailable. The Miles plant has the need for disposal of 320 cubic yards of calcium sulfate per day. The site has proper zoning from the City of Elkhart.

Owner: Miles Laboratories, Inc.

Operating Procedures: The trench method of sanitary landfill operation is proposed. The maximum depth of excavation will be 4 feet. The calcium sulfate will be compacted in 6-inch layers to the total thickness of 3 feet. A weekly cover of six inches of soil will be applied. A final cover of one foot of soil will be applied.

Recommendations: It is recommended that the Board grant construction plan permit number SW 169 for the proposed experimental industrial landfill with the following conditions:

1. That only calcium sulfate be deposited at this site.
2. That at no time may calcium sulfate be deposited into water.
3. That monitoring wells be installed and tested on a quarterly basis as described in the plans and specifications submitted on March 12, 1975 (copy enclosed).
4. That in the event any of the monitoring wells do show an appreciable increase of calcium or sulfate levels approaching Public Health Service Drinking Standards, Miles Laboratories, Inc. will cease disposal operations and undertake corrective action.
5. That a [REDACTED] and topsoil may be used as weekly cover, with the [REDACTED] cover to consist of at least two feet of clay soil.

JRBaker/mc
4/15/75

II

II. Common Definitions

Websters Collegiate Dictionary: 5th Edition: Gypsum: Mineral. Hydrous calcium sulphate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. H. 2. Sp. Gr., 2.31-2.32. Gypsum is used as a dressing for soils, for making plaster of paris, etc. -V.T. to treat with gypsum, as soil or water.

Food Chemicals Codex

1st Edition: Calcium Sulfate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$): a fine, white to slightly yellow-white, odorless powder. It is slightly soluble in water, but dissolves in dilute hydrochloric acid solutions.

The Condensed Chemical Dictionary - Fifth Edition

Terra alba $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ Finally pulverized powder made from gypsum and used in the manufacture of paper, paints, artificial marble, and composition plastics.

Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. A natural hydrated calcium sulfate.

The National Formulary

Thirteen Edition - Calcium sulfate occurs as a fine, white to slightly yellow - white, odorless powder.

III

III. Occurrence, And Properties

Gypsum. This material properly defined, is the natural mineral of calcium sulfate dihydrate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ -sp gr. 2.31-2.33; Mohs hardness, 1.5-2. It is widely and abundantly distributed in nature and occurs in an interesting variety of forms, conditions, associations, and colors. In pure form, gypsum is snow-white and occurs in stratified layers, doubtless of marine origin. Either because of varying conditions at the time of precipitation or through recrystallization, the mineral occurs in various conditions from hard, solid rock to fragmentary and granular forms. In some deposits the rock occurs in easily friable masses of coarsely crystalline beds, which are appropriately called "sugar rock." Many deposits yield the massive mineral through the body of which occur crystals of selenite (see below), these deposits being described as selenitic gypsum. Most deposits of gypsum occur closely associated with either strata or random occurrences of the mineral anhydrite, suggesting a question of the geological origin and the possible transformation of one form into the other after deposition.

Gypsum is widely distributed over the earth and is commercially available in quantity in most industrial nations. More than one-third of the states in the U.S. have abundant resources, as reported in the Minerals Yearbook.

The mineral occurs normally in horizontal strata or veins varying from a few inches to many feet in thickness. Open-pit or strip mining is employed for deposits near the surface; both slope and shaft mines are common for deeper deposits. The importance of the mineral gypsum as a source of almost all commercial forms of calcium sulfate is shown by the fact that in 1962 there were approximately 68 gypsum plants in the U.S., distributed through 22 states and operating 16 underground mines, 54 open quarries, and a number of mine-quarry combinations.

Gypsum dissolves in water to the maximum solubility of approximately 2.1 g/liter at about 40°C and has the lower solubility of approximately 1.8 at 0°C and 1.9 in the range of 70-90°C. The concentration varies erratically with traces of electrolytes and variations in pH and, preferably, should be determined experimentally for all systems other than pure water solutions.

Alabaster. This is massive, densely crystalline, softly textured form of practically pure gypsum. It is usually translucent and frequently tinted with beautifully variegated colors due, probably, in some cases, to optical effects in the crystalline mass and, in other cases, to traces of foreign materials. Several deposits in Colorado supply practically all of the alabaster used in the U.S. These deposits furnish the mineral in white and a variety of attractive color tints and blends. The mineral is taken from the mines with care in moderate to large lumps.

Alabaster, being relatively soft yet dense and fine-textured, is easily worked by the carving knife and the saw, and may be readily shaped by abrasive papers and polished to a fine smooth finish. Much of the shaping and finishing of alabaster is done while the stone is kept wet. Alabaster has been known and used for the carving of cruses, urns, and other small vessels, and for the making of images, statuary, and other art objects. Many ancient structures have been embellished by columns, porticoes, and other decorative finishes of alabaster.

Selenite. It is a pure form of gypsum crystallized in the monoclinic system in the form of sheets or plates that show a perfect and easy cleavage parallel to the plane of crystallization. Sheets or slabs of selenite occur in sizes up to several feet in width and length, and these sheets, with characteristic oblique corners, break down in parallelograms of similar proportions. Selenite crystals up to several inches in thickness are completely transparent. Thin sheets of selenite polarize light and are used in laboratory equipment for this purpose. Selenite does not have the elastic return of mica and, when once distorted, remains so.

Satin Spar. This is another form of pure crystalline gypsum and is known as gypsum var. satin spar (not to be confused with calcite var. satin spar, CaCO_3). The crystals are monoclinic and in the form of parallel threads. A mass of satin spar, therefore, resembles somewhat the common forms of asbestos and, in many cases, the threads can be picked or raveled out of the mass. In the more densely formed growths, satin spar is translucent and lends itself readily to fabrication and polishing into trinkets and small art objects. Satin spar is formed in seams, sutures, and faults in or near gypsum deposits by the precipitation from, or the evaporation of, ground water carrying the mineral in solution. It is, accordingly, sometimes called secondary gypsum. Formations of satin spar are frequently observed in abandoned mines and in the joints of masonry through which gypsiferous water reaches the open air.

Anhydrite. The natural mineral form of anhydrous calcium sulfate is known as anhydrite; it has a sp gr of approximately 2.8-2.9, and a Mohs hardness of 3-3.5. It is usually densely massive and frequently shows light tints of color as blue, pink, etc. Anhydrite has the same solubility in water as gypsum but does not react rapidly to form hydrates. It is, accordingly, less valuable as a raw material when this property is desired. It can be used as a sulfate source for ammonium sulfate.

Gypsite. This is an earthy deposit at or near the surface of the ground and consists of finely crystalline gypsum mixed with loams, clays, sands, and humus; it ranges from 60 to more than 90% gypsum. These deposits are formed by the movement of ground water carrying gypsum in solution and the deposit of the mineral by evaporation at the surface, or as windblown "loccos" from disintegrating rock deposits. Surface beds or quarries of gypsite, chiefly in the southwestern states, have been worked in the production of plaster, structural tiles, etc., in the building industry but, in general, are at present of little commercial importance.

Gypsum Sands. Enormous deposits of practically pure gypsum in the form of fine, white sands occur at various points in Arizona, New Mexico, and Texas. These sands, covering many thousands of acres in some deposits, appear as drifts and dunes and are doubtless the result of evaporation of gypsum-bearing water rising to the surface of the earth through seepage springs or by uniform movement over wide areas of land. This is a natural result of the normal arid condition of the atmosphere in these regions. Practically without exception these deposits are contaminated with sodium sulfate to such an extent that they are valueless for structural or hydraulic purposes.(3)

IV

IV. Uses

Gypsum, as such, has only a few major uses but these are important. In the manufacture of portland cement gypsum is a necessary ingredient and is used to lengthen the time of setting of various cements and mortars to allow for depositing and placing in forms. The "raw" gypsum is moved to the cement plants, usually in open cars, in the form of rock crushed to about 1.5 in. and finer. Automatic machines charge the crushed gypsum into the flow of cooled clinker in the amount of 3-5% as the mixture goes to the grinding mills.

In some foreign countries (as Germany), gypsum has been used as a source of lime, CaO , in the manufacture of portland cement. This involves the complete decomposition of the gypsum at the temperature of the cement kiln and then recovery of sulfur trioxide, SO_3 , as a by-product.

An important large-scale use of gypsum is in the treatment of soils, particularly those used for leguminous crops and in the culture of peanuts. For this use the gypsum (or occasionally anhydrite) is finely ground and is known as "land plaster." Benjamin Franklin is credited with the introduction into the U.S. of this application as the result of his observations in France. Finely ground gypsum, when mixed with manures, acts to stabilize the volatile and dissolved nitrogenous compounds, thus preventing their loss by volatilization and leaching. A major use in arid climates is neutralization of "black alkali" soil by reaction with the alkali carbonates that cause this condition.

As a stable, nontoxic, tasteless, odorless, nonabrasive, practically chemically inert powder, known as terra alba, gypsum is used in paints, pharmaceuticals, paper filling, insecticide dusts, yeast manufacture, water treatment, and many other industries. In brewing, it may be added to the water to lower the pH of the mash.

Some Recent Developments in the Use of Gypsum. Low-grade nickel ore is subjected to sulfide smelting by the addition of coal and gypsum in a continuous reverberatory furnace operated at 1300°C . The ore is crushed to 10 mm size.

Calcium sulfate and coke are heated in an electric furnace to give calcium carbide, carbon dioxide, carbon monoxide, and sulfur. The proportion of anhydrite to coke is 1.4:0.6.

Sulfuric acid is prepared by heating gypsum at 1200°C to produce sulfur trioxide. The required temperature can be lowered to 1000°C by the addition of quartz and the velocity increased by the addition of sodium chloride and moist air. A yield of 99% SO_3 is reported.

Ammonium sulfate is produced from calcium sulfate by reacting it with ammonia, carbon dioxide, and water. Calcium carbonate is produced as a by-product.

Gypsum is added to opal or transparent soda-lime or soda-potash-lime glasses as a coloring agent. The combined sulfur is reduced by elemental silicon or aluminum to produce colors varying from ivory to amber.

Porous polytetrafluoroethylene (Teflon) is made by mixing an aqueous dispersion of the polymer with plaster of Paris, pouring the mixture into a mold, and heating it until the polymer fuses. The plaster of Paris is then dissolved out, leaving a porous molded product.

For proper gel formation of certain food products a source of calcium ions is required. Calcium salts used for this purpose include calcium citrate, calcium gluconate, calcium glycerophosphate, calcium hypophosphite, di- and tricalcium phosphates, and calcium sulfate.

Water used in the brewing industry is often "corrected" to a uniform mineral salt content that corresponds to water known to give the most satisfactory final product. A wide variety of salts are used for this purpose, including mono- and diammonium phosphate, calcium chloride, calcium hydroxide, calcium oxide, calcium dihydrogen phosphate, calcium sulfate, magnesium sulfate, potassium aluminum sulfate, potassium chloride, potassium sulfate, sodium bisulfate and mono-, di-, and trisodium phosphates. Some of these chemicals, in addition to standardizing the salt content, also control the acidity, thus providing uniform conditions for yeast fermentation.

Three basic types of gypsum (calcium sulfate) derivatives provide the dental industry with the basis for a variety of useful materials. The versatility and usefulness of gypsum depend upon the ease, character, and reversibility with which the water of crystallization, and the attendant crystal form, can be altered. Fundamentally, a partial dehydration from the dihydrate form, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, to the hemihydrate form, $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$, of calcium sulfate is achieved by heating. The mode of applying the heat, and the conditions under which the partial dehydration occurs, alter the physical characteristics of the resulting crystal and provide the three basic types of gypsum derivatives (plaster; Hydrocal (United States Gypsum Co.); Densite (Certain-Teed Products Corp.); and low-consistency hydrocal). In use, the powdered calcium sulfate hemihydrate, $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$, which has been formulated into a useful product, is mixed with a prescribed quantity of water to form a slurry. The partially dehydrated calcium sulfate, $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$, will recombine with the mixing water, and recrystallize, to again form the dihydrate of calcium sulfate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. The solution of the hemihydrate, followed by the recrystallization of the dihydrate, results in a crystalline growth which solidifies the entire mix into a structurally strong and useful mass.

The natural or unmodified hardening time for plaster of Paris is in the range of 5-120 min. However, this entire family of materials is subject to considerable modifications to adapt them for a variety of useful dental materials.

Many of the newer therapeutic agents are of extremely high potency, thereby requiring only fractions of a milligram per dose. In such cases, the tablet consists mainly of inert filler providing bulk so that a tablet of suitable size for ease of handling by the manufacturer, pharmacist, and patient can be manufactured. These fillers or excipients may be lactose, mannitol, sucrose, calcium sulfate, calcium phosphate, or microcrystalline cellulose. In addition, other agents such as binders (tragacanth, acacia, starch paste, methylcellulose, etc), disintegrants (corn starch, alginic acid, microcrystalline cellulose), and lubricants (stearic acid, magnesium stearate, calcium stearate, Carbowax, and talcum) are usually added to the tablet formulation.

Production of phosphoric acid by the wet process involves the steps of (1) dissolving phosphate rock in sulfuric acid, (2) holding the acidulate slurry until the calcium sulfate crystals grow to adequate size, (3) separating the acid and calcium sulfate by filtration, and (4) concentrating the acid to the desired level. The reaction for the process used most extensively is as follows:



The National Formulary - Thirteenth Edition
V. Specifications For Food Grade Material

Calcium Sulfate is anhydrous or contains two molecules of water of hydration. When dried at 250° to constant weight, it contains not less than 99.0 percent and not more than 101.0 percent of CaSO_4 .

Description - Calcium Sulfate occurs as a fine, white to slightly yellow-white, odorless powder.

Solubility - Calcium Sulfate dissolves in diluted hydrochloric acid. It is slightly soluble in water.

Identification - Dissolve about 200 mg. of Calcium Sulfate by warming in a mixture of 4 ml. of diluted hydrochloric acid and 16 ml. of water. This solution responds to the tests for Calcium, and for Sulfate.

Loss on Drying - Dry Calcium Sulfate at 250° to constant weight: the anhydrous form loses not more than 1.5 percent of its weight; the dihydrate loses not less than 19 percent and not more than 23 percent of its weight.

Carbonate - Mix 1 g. of Calcium Sulfate with 5 ml. of water, and add a few drops of diluted hydrochloric acid: no effervescence occurs when the acid is added.

Iron - Dissolve 200 mg. of Calcium Sulfate and about 50 mg. of ammonium persulfate in 10 ml. of diluted hydrochloric acid, dilute to 50 ml. with water, and mix. To this solution add 3 ml. of ammonium thiocyanate T.S., and mix thoroughly: the color obtained is no darker than that produced in 50 ml. of a solution containing 140 mcg. of ferrous ammonium sulfate (equivalent to 20 mg. of Fe) when treated in the same manner (100 parts per million of Fe).

Heavy metals - Mix 2 g. of Calcium Sulfate with 20 ml. of water, add 25 ml. of diluted hydrochloric acid, and heat to boiling to dissolve the sample. Cool, and add stronger ammonia water to a pH of 7. Filter, evaporate to a volume of about 25 ml., and refilter if necessary to obtain a clear solution: the heavy metals limit for Calcium Sulfate is 10 parts per million.

Assay - Dissolve about 300 mg. of Calcium Sulfate, previously dried at 250° to constant weight and accurately weighed, in 100 ml. of water and 4 ml. of diluted hydrochloric acid. While stirring, preferably with a magnetic stirrer, titrate as follows: add about 30 ml. of 0.05M disodium ethylenediaminetetraacetate from a 50-ml. buret, then add 15 ml. of sodium hydroxide T.S. and 300 mg. of hydroxy naphthol blue, and continue the titration to a blue endpoint. Each ml. of 0.05 M disodium ethylenediaminetetraacetate is equivalent to 6.807 mg. of CaSO_4 .

Packaging and storage - Preserve Calcium Sulfate in well-closed containers.

Labeling - The label should indicate whether the Calcium Sulfate is anhydrous or the dihydrate.

Food Chemicals Codex - First Edition
Specifications For Food Grade Material cont'd

$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Calcium Sulfate

Description - A fine, white to slightly yellow-white, odorless powder. It is slightly soluble in water, but dissolves in dilute hydrochloric acid solutions.

Identification - Dissolve about 200 mg. by warming with a mixture of 4 ml. of diluted hydrochloric acid T.S. and 16 ml. of water. A white precipitate

forms when 5 ml. of ammonium oxalate T.S. is added to 10 ml. of the solution. Upon the addition of barium chloride T.S. to the remaining 10 ml., a white precipitate forms which is insoluble in hydrochloric and nitric acids.

Specifications - Assay. Not less than 99 percent and not more than the equivalent of 105 percent of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.

Limits of Impurities - Arsenic (as As). Not more than 3 parts per million (0.0003 percent).

Fluoride. Not more than 30 parts per million (0.003 percent).

Heavy Metals (as Pb). Not more than 10 parts per million (0.001 percent).

Selenium. Not more than 30 parts per million (0.003 percent).

TESTS

Assay. Dissolve about 350 mg., accurately weighed, in 100 ml. of water and 4 ml. of diluted hydrochloric acid T.S. While stirring, preferably with a magnetic stirrer, add about 30 ml. of 0.05 M di-sodium ethylenediaminetetraacetate from a 50-ml. buret, then add 15 ml. of sodium hydroxide T.S. and 300 mg. of hydroxy naphthol blue indicator, and continue the titration to a blue end-point. Each ml. of 0.05 M disodium ethylenediaminetetraacetate is equivalent to 8.609 mg. of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.

Arsenic. Mix 1 gram with 10 ml. of water, add 12 ml. of diluted hydrochloric acid T.S., and heat to boiling to dissolve the sample. Cool, filter, and dilute the filtrate to 35 ml. with water. This solution meets the requirements of the Arsenic Test.

Fluoride. Weigh accurately 1.67 grams, and proceed as directed in the Fluoride Limit Test.

Heavy metals. Mix 2 grams with 20 ml. of water, add 25 ml. of diluted hydrochloric acid T.S., and heat to boiling to dissolve the sample. Cool, and add ammonium hydroxide to a pH of 7. Filter, evaporate to a volume of about 25 ml., and refilter if necessary to obtain a clear solution. This solution meets the requirements of the Heavy Metals Test, using 20 mcg. of lead ion (Pb) in the control (Solution A).

Selenium. A solution of 2 grams in 40 ml. of dilute hydrochloric acid (1 in 2) meets the requirements of the Selenium Limit Test.

Packaging and storage. Store in well-closed containers.

Functional use in foods. Nutrient supplement; yeast food; dough conditioner; firming agent.

VI

Page 9

VI. Typical Analysis

The process for converting wet Calcium Sulfate cake to Food Grade $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ is simply one of drying. The wet cake contains 24-29% free water. When dried, the typical analysis is as follows:

Description	White to off white powder
pH	4.5 @ 20°C
Iron	15.3 ppm
Heavy Metals	* LT 10 ppm
Fluoride	0.15 ppm
Selenium	Neg.
Assay	99.81%
Loss on Drying	19.7%
Identification	Passes Test
Arsenic	* LT 3 ppm
Carbonate	Neg.
Solubility	Passes Test

*Less than

REFERENCES:Page 1, footnote (1):

Abstracted from The Merck Index - 8th Edition, Page 196, Pub. Merck & Co., Inc.
Rahway, N.J., U.S.A. 1968

Page 1, footnote (2):

K. K. Kelly, J. C. Southard, and C. T. Anderson, U. S. Beer Mines Tech. Papers,
625, 3 (1941)

Page 4, footnote (3):

Review: Hammond in Kirk-Othmer Encyclopedia of Chemical Technology, Vol. 4,
2nd Edition, Interscience, 1964.

VII

November 20, 1974

LEACHING STUDIES ON CALCIUM SULFATE

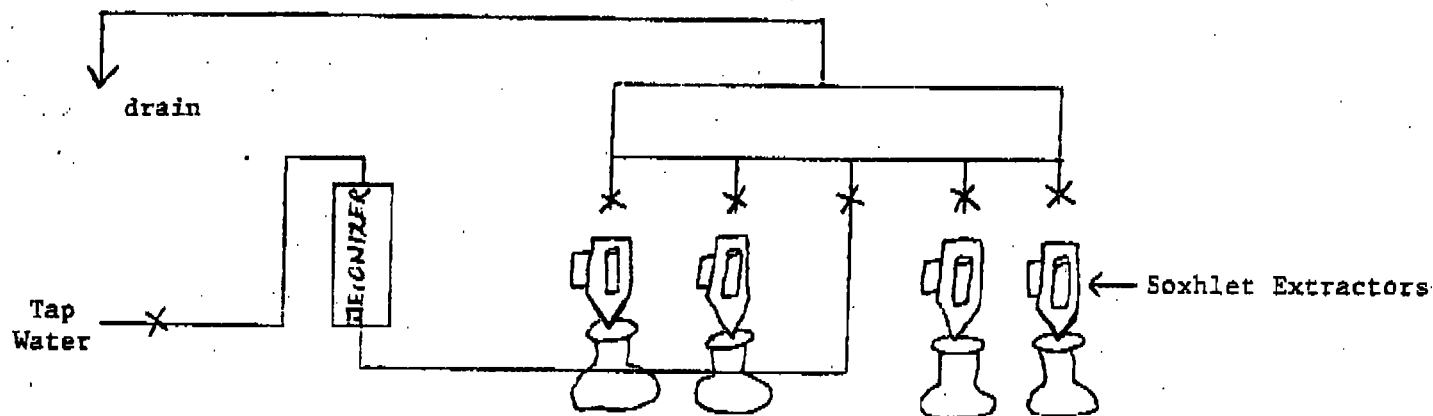
A leaching study was performed on both the wet calcium sulfate as it now is, and on repulped calcium sulfate, which will be representative of the calcium sulfate after March 1, 1975, at which time the calcium sulfate will be filtered then repulped in water and again filtered. Test design and results follow:

Test Design

Tap water was run through an IWT ion exchanger research model II available from Campbell Industrial Sales, P.O. Box 629, Carmel, Indiana. The deionizer fed a four spigot manifold with flow control valves at each spigot.

50 grams each of wet calcium sulfate cake, repulped calcium sulfate cake, and a control of local soil, were placed in separate Whatman Cellulose Extraction Thimbles - single thickness - 33 x 94 mm. An empty thimble was used in the fourth unit as a blank.

The deionized water was dripped into the thimbles at a rate of 200 ml/hour and collected for chemical analysis. Three 200 ml. extractions were collected for each sample. All cation results are by atomic absorption. The aliquot used was first concentrated by four, then acidified with HCl and analyzed. All other test procedures are explained with the data. All data is expressed - as is - in the 200 ml. segment collected. All extractions done at ambient temperatures, approximately 72°F.



I

Test	Wet Calcium Sulfate Cake		
	1st	2nd	3rd
Calcium ppm	625	585	575
Magnesium ppm	1.4	.08	.025
Sulfate ppm(1)	1504	1455	1306
Iron ppm	.4	LT.05	LT.05
Copper	.11	.07	.10
Zinc ppm	.10	.01	.02
Chromium ppm	LT.025	LT.025	LT.025
Aluminum ppm	LT.05	LT.05	LT.05
Silica ppm	1.5	.5	.5
Sodium	6.4	0.6	.43
Manganese ppm	0.9	LT.025	LT.025
Molybdenum ppm	LT.05	LT.05	LT.05
Potassium ppm	2.7	.27	.12
Chloride(2)	LT10	LT 10	LT 10
Total Dissolved Solids(3) ppm	1925	1983	1769
pH at 25°C	3.30	4.7	4.87
Total Acidity(4)	<u>10 ml</u>	<u>10 ml</u>	<u>10 ml</u>
Normal NaOH	100 ml	100 ml	100 ml
Color O.D.(5)	.05	.05	.05
Free Acid Concent	LT.01%	LT.01%	LT.01%
Heavy Metal(6)	LT3ppm	LT3ppm	LT3ppm

II

Test	Repulped Calcium Sulfate Cake		
	1st	2nd	3rd
Calcium ppm	683	330	284
Magnesium ppm	.065	.05	LT .02
Sulfate ppm	960	636	662
Iron ppm	.2	LT.05	LT .05
Copper	.12	.10	.07
Zinc ppm	.11	.02	.01
Chromium ppm	LT.025	LT.025	LT.025
Aluminum ppm	LT.05	LT.05	LT.05
Silica ppm	.9	.8	1.0
Sodium	4.4	.8	.42
Manganese ppm	.05	.04	LT.025
Molybdenum ppm	LT.05	LT.05	LT.05
Potassium ppm	1.7	.24	.05
Chloride(2)	LT 10	LT 10	LT 10
Total Dissolved Solids(3) ppm	1253	889	907
pH at 25°C	3.31	4.44	5.00
Total Acidity(4)	<u>10 ml</u>	<u>10 ml</u>	<u>10 ml</u>
Normal NaOH	100 ml	100 ml	100 ml
Color O.D.(5)	.05	.05	.05
Free Acid Concent	LT.01%	LT.01%	LT.01%
Heavy Metal(6)	LT3ppm	LT3ppm	LT3ppm

III

Test	Elkhart Soil		
	1st	2nd	3rd
Calcium ppm	150	2.0	2.1
Magnesium ppm	1.2	1.0	.44
Sulfate ppm	20	10	LT 10
Iron ppm	3.7	2.2	1.0
Copper	.15	.11	.06
Zinc ppm	.06	.04	.01
Chromium ppm	LT.025	LT.025	LT.025
Aluminum ppm	1.2	.09	.25
Silica ppm	5.1	4.0	4.1
Sodium	22	4.4	0.4
Manganese ppm	.42	.11	.05
Molybdenum ppm	LT.05	LT.05	LT.05
Potassium ppm	2.4	1.2	.51
Chloride(2)	LT 10	LT 10	LT 10
Total Dissolved Solids(3) ppm	125	40	42
pH at 25°C	6.42	6.74	6.62
Total Acidity(4)	<u>6 ml</u>	<u>10 ml</u>	<u>9 ml</u>
Normal NaOH	100 ml	100 ml	100 ml
Color O.D.(5)	2.30	0.65	0.45
Free Acid Concent	LT.01%	LT.01%	LT.01%
Heavy Metal(6)	LT3ppm	LT3ppm	LT3ppm

IV

Test	Deionized Water Used	
	1st	2nd
Calcium ppm	1.4	.23
Magnesium ppm	.22	.04
Sulfate ppm	neg	neg
Iron ppm	LT.05	LT.05
Copper	.1	.1
Zinc ppm	.02	.005
Chromium ppm	LT.025	LT.025
Aluminum ppm	.11	LT.05
Silica ppm	3	2.1
Sodium	1.2	.40
Manganese ppm	LT.025	LT.025
Molybdenum ppm	LT.05	LT.05
Potassium ppm	.12	.025
Chloride(2)	neg	neg
Total Dissolved Solids(3) ppm	0	0
pH at 25°C	4.60	4.60
Total Acidity(4)	<u>10 ml</u>	<u>10 ml</u>
Normal NaOH	100 ml	100 ml
Color O.D.(5)	-	-
Free Acid Concent	LT.01%	LT.01%
Heavy Metal(6)	LT3ppm	LT3ppm

Abbreviations: LT = Less Than

ANALYTICAL PROCEDURES1. Sulfate

50 mls. sample + 1 g. BaCl_2 . Filter through a weighed crucible with asbestos mat. Rinse with methyl alcohol, dry at 105°C for 2 hours. Record weight gain as BaSO_4 .

$(\text{mg. BaSO}_4) \times 0.412 = \text{wt. SO}_4 \text{ 50 mls. in mgs.}$
 $\text{wt. SO}_4 \text{ in 50 mls.} \times 20 = \text{ppm SO}_4$

2. Chloride

(Volhard Method) Standard Methods for the Examination of Water, Sewerage and Industrial Wastes, Tenth Edition, page 59.

3. Total Dissolved Solids

As above pg. 178 - Total Residue

4. Total Acidity

As above pg. 34

5. Color

Direct spectrophotometer reading at 420 nm vs. blank.
Lumetron used, 19 mm rounded curvette.

6. Heavy Metals - U.S.P. XIII